

**NATIONAL INSTITUTE FOR AVIATION RESEARCH
WICHITA STATE UNIVERSITY
WICHITA, KANSAS 67260-0093**

**CONTINUED ELECTROMAGNETIC PROTECTION
INTEGRITY OF AIRCRAFT AND SYSTEMS ñ PHASE I
FAA CONTRACT NO: 00-C-WSU-00-1**

John B. O'Loughlin

HISTORICAL LIGHTNING STRIKE DATA ANALYSIS AND RESULTS

The historical lightning strike data analysis, for FAA/NIAR TASK FOUR of "Continued Electromagnetic Protection Integrity of Aircraft & Systems Phase-I" research, was conducted to study and review lightning strike data that has been compiled from the forms filled out by pilots and maintenance personnel and the corresponding maintenance history of that aircraft. The general purpose of the study was to develop a better understanding of which factors were most influential in affecting the severity of aircraft lightning strike damage of in-service aircraft and their systems, to help justify design changes and cost reductions, and to improve reporting and data collection procedures.

There were 95 incident reports on various aircraft models in the Lightning Strike Database (LSD), used for this study. Some initial analysis was done to ensure that the data from these reports cover several variables. When differences were seen, they were investigated. In order to validate that the data in the LSD was representative of all in-service aircraft in terms of flight-hour distribution, a comparison was done between the aircraft involved in the lightning strike incidents and all in-service aircraft of the same model. The results of the comparison showed good agreement.

The two variables studied, with respect to lightning damage, were the age of the aircraft and the level of high intensity radiation field (HIRF) protection. The level of HIRF protection on different aircraft models in the database was categorized as full protection, avionics protection, and no protection. The study with respect to the age of the aircraft was only performed on aircraft in the avionics protected category, because this category had the most aircraft with the largest age distribution.

Following is a summary of results, after analyzing the data in the LSD:

- The age of the aircraft had no observable impact on the electrical failure rate as a result of a lightning strike, given the limited data in the LSD. Figure 1 shows the electrical failure rate as a function of aircraft age, which shows a constant failure rate as the aircraft ages.
- HIRF protected aircraft have significantly lower failure rates as compared to non-protected aircraft. Figure 2 is a plot of lightning strikes and corresponding electrical failures and electrical interferences. As seen, the HIRF protected aircraft had no

electrical failures and a significantly lower interference rate as compared to less or unprotected aircraft.

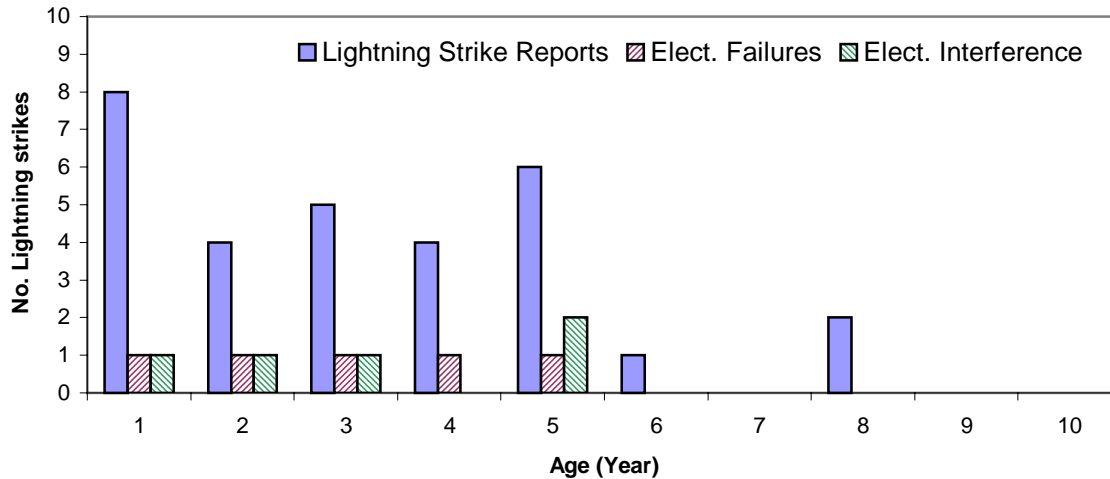


FIGURE 1. ELECTRICAL FAILURES/ INTERFERENCE ON AVIONICS PROTECTED AIRCRAFT OVER AGE

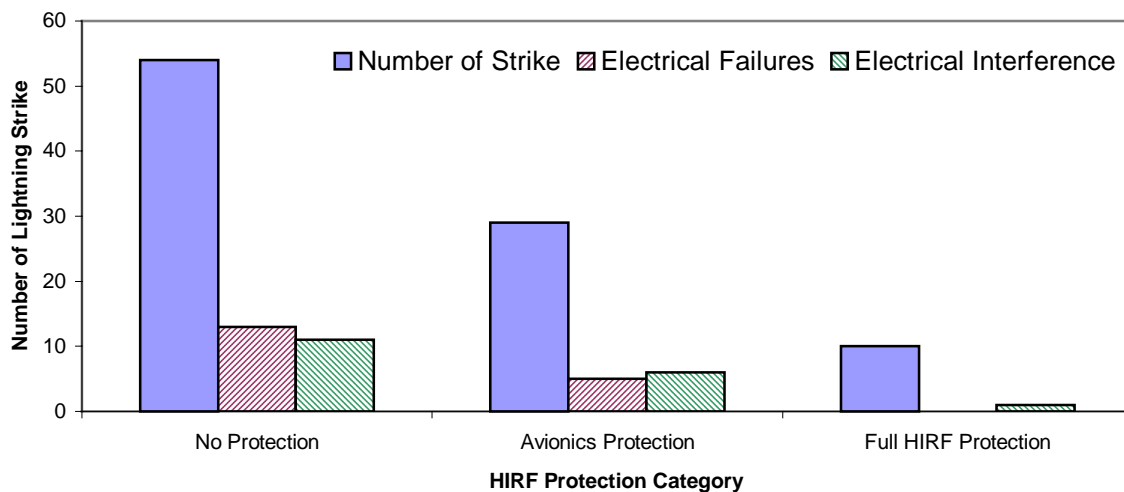


FIGURE 2. SUMMARY OF AIRCRAFT PROTECTION VS. ELECTRICAL FAILURES

A revision to lightning strike reporting form has also been suggested as a result of this study. There are few important parameters, which are not being collected in the existing lightning strike form. These parameters could be valuable in the analysis of the aircraft lightning strikes. It could help in evaluating the causes of the damages due to the lightning strike and in determining the possible design changes to avoid any future damage to the aircraft.